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PERFORMANCE EVALUATION TEAM

MISSION 1207

AUGUST 1974

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PUBLICATION REVIEW

This report has been reviewed and is approved.

Lt Col, USAF
Chairman, Performance Evaluation Team

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FOREWORD

This report was prepared for and by direction of the Director of Special Projects, Office of the Secretary of the Air Force. The report is Volume I of the final mission report for HEXAGON Mission 1207. Volume II is entitled, "Sensor Subsystem Post Flight Analysis Report," TCS 363505-74.

The report was prepared by the SAFSP HEXAGON Performance Evaluation Team (PET) using reports and data provided by SAFSP, the Technical Advisor (TA) Staff, Post Flight Analysis (PFA) Team, and HEXAGON Satellite Vehicle Integrating Contractor (SVIC).

The PET Team Members are:

SAFSP-7

[redacted]

Capt James P. Collins

[redacted]

Editorial assistance and publication services were provided by the Air Force Special Projects Production Facility (AFSPPF). The PET wishes to commend Colonel Clark E. Davison, Commander, and his most able staff for their support.

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SECTION I

SUMMARY

1.1 INTRODUCTION

The seventh HEXAGON Satellite Vehicle (SV) was placed into the nominal 88 x 154 NM orbit by the Titan III D Booster on 10 November 1973. Ascent events were all nominal and proper stabilization of the SV allowed initiation of deployment of the solar arrays at the first station contact. [redacted] Subsatellite (+Y) was properly ejected on Rev 2. The SSU (-Y) Subsatellite was properly ejected on Rev 13. Preflight mission planning included a 45 day Mapping Camera mission, a 90 day Panoramic Camera mission, and a 30 day Solo operation. The Panoramic Camera operated throughout the mission and its RVs were aerially recovered on Days 15, 38, 65, and 103. All of the film was transported into the RVs including 4,983' of SO-255 Color Film in RV-1 and 501' of FE-3916 Infrared Color in RV-4. During the 1207-1 Post Flight Analysis (PFA), it was determined that a metering capstan resonance at peak Vx/h values was affecting image quality, and the perigee altitude was raised two miles by OA-8 on Rev 289. All other Panoramic Camera operations were normal. All the Mapping Camera operations were normal and 98.4% of the film was transported to RV-5 which was aerially recovered on Day 58. Solo tests were completed and the SV was deorbited on Rev 1998 (Day 124).

SECTION II

MISSION OVERVIEW

2.1 PREFLIGHT PLANNING

Mission 1207 represents the first of the HEXAGON Block II Vehicles and Panoramic Camera Systems. Soft seat RCS valves were installed and because of their expected leak proof performance, RCS fuel was to be drawn from RCS Tanks 1 and 2 (Tanks 3 and 4 were removed) before using the OA Tank. The OA Tank was loaded with 3,200 pounds of fuel. The Panoramic Camera System deleted the anti-telescope cage of the Supply unit and was instrumented to monitor the SU response during launch.

2.2 PREFLIGHT CONSTRAINTS

The Mission 1207 orbit was designed to:

A. Maintain solar angle (Beta) within +2° to -8° for the planned 90 days.

B. Have orbit adjusts occur on a three-day cycle with every third OA having a positive and negative burn for close control of argument of perigee.

2.2.1 Panoramic Camera System Constraints

The following constraints were imposed on the Panoramic Cameras:

A. Rewind velocity limited to 5 inches/second.

B. No 30° scans at ±45° scan centers.

2.3 LAUNCH BASE

The SV was delivered to the launch pad and mated to the BV on 25 October 1973. The vehicle was launched on 10 November 1973, at 1210:00.45 PST at the opening of the launch window.

2.4 ASCENT

The BV successfully injected the SV into an 88.67 x 154.40 NM orbit. The achieved orbit was close to nominal with the following deviations:

Apogee Altitude (NM)	.442
Perigee Altitude (NM)	.476
Period (second)	-.42
Eccentricity	-.000290
Argument of Perigee (degrees)	-4.6
Inclination (degrees)	.028

2.5 ORBIT AND RECOVERY

2.5.1 1207-1 (Fourteen Days Duration)

Solar array deployment was executed over INDI on Rev 1 with normal deployment and erection.

On Rev 1 at KODI, the solar arrays were repositioned from 18 to 0 degrees. [redacted] Subsatellite was ejected on Rev 2 and the SSU Subsatellite was ejected on Rev 13. The DBS Antenna was deployed on Rev 12.

Operational photography began on Rev 5 following successful completion of the constant velocity and health checks. An unexplained telemetry loss during a portion of the health checks on Rev 3 precluded verification of OOAA nominal setting execution. However, these commands were re-issued and verified on Rev 5. Normal operation was exhibited throughout this segment. Approximately 29,000' of Forward Camera film and 27,400' of Aft Camera film (including 5,010' of SO-255 Color Film) were exposed and stowed in RV-1. These values include the prelaunch footage on the Take-up.

Post flight analysis of the recovered film showed that the overall quality of the acquired photography ranged from Very Good to Fair with the majority rated as Good. Exposure reduction and OOAA in-track smear adjustments for the Aft Camera were established and a Forward Camera metering capstan resonance at peak Vx/h values affecting image quality was identified. A recommendation was made to raise the orbit perigee altitude to avoid the troublesome region and thereby improve image quality.

RV-1, loaded to 100% capacity, was successfully re-entered and aerially recovered on Rev 229 (Day 15).

2.5.2 1207-2 (Twenty-Three Days Duration)

Normal operational photography continued throughout this segment. The PFA recommended Aft Camera OOAA and exposure adjustments were made on Revs 282 and 285 respectively, while the perigee adjustment recommended for the Forward Camera metering capstan resonance was made on Rev 289. Approximately 26,000' of film per camera were exposed and stowed in RV-2. PFA showed overall quality of acquired photography to range from Very Good to Poor with the majority rated as Fair. This general decrease was attributed to increasing haze and to decreasing illumination and contrast in the northern latitudes.

RV-2, loaded to 88.5% capacity, was successfully re-entered and aerially recovered on Rev 602 (Day 38).

2.5.3 1207-3 (Twenty-Seven Days Duration)

Normal photographic operation continued throughout this segment. Approximately 29,000' of film per camera were exposed and stowed in RV-3. PFA showed overall quality of acquired photography to range from Good to Poor but with the majority still rated Fair. Generally poor weather and snow cover were additional factors contributing to lower quality. A "U"-shaped tear was found on one frame of the Aft Camera. The review of telemetry showed only slight disturbances in the coarse film path at this point and good imagery on this frame identifies that the tear occurred after exposure. Subsequent analysis established the most probable cause as ingestion of a connector dust cap in the Take-up area.

RV-3, loaded to 99.3% capacity, was successfully re-entered and aerially recovered on Rev 1039

(Day 65).

2.5.4 1207-4 (Thirty-Eight Days Duration)

Normal photographic operation continued through this final segment. Approximately 23,400' of film per camera were exposed and stowed in RV-4. PFA showed overall quality of acquired photography to range from Good to Poor with the majority rated as Fair. A large portion of this segment's photography was significantly better than that of the previous segments because of more low latitude acquisitions and improved weather conditions. Poor weather and poor illumination were the causes of low quality rather than system degradation with life.

RV-4, loaded to 80.4% capacity, was successfully re-entered and aerially recovered on Rev 1656 (Day 103). Some parachute cone damage occurred and one suspension line was broken.

2.5.5 1207-5 (Fifty-Eight Days Duration)

The performance of both the Stellar and Terrain Cameras was judged successful with only a minor light leak in the Stellar Chute detracting from an otherwise excellent ST mission. A puncture in an Aft Stellar Chute section resulted in superimposed imagery (pinhole camera effect) of the Pressure Makeup System (PMS) equipment on one Stellar frame pair of each operation. Weather conditions were fair to good with 71% of the photography being 90% cloud free. The exposure levels were within the accuracy of the exposure algorithm and no changes are recommended for Mission 1208. The results obtained using 3414 Film in the Terrain Camera were excellent. Exposure levels were correct and the performance increase noted on the small sampling confirmed the optimism toward using 3414 as the primary film load for Mission 1209.

A total of 2,102 Terrain frames and a corresponding number of Stellar frame pairs were exposed in the ST System. Included in these frames were 18 frames on 3414 Film and 15 frames exposed for in-flight starfield calibration.

Photography of the Comet Kohoutek was planned to follow the calibration; however, on the first frame the film left the Supply unit and mistracking probably occurred due to the lack of tension. This resulted in stalling the Terrain Camera Transport System. The cut and seal operation separated the tag end since the system could not complete the film runout. After the RV-5 was ejected, the system was run using the Backup Mode. No corrective action is contemplated for Mapping Camera Module 4 (MCM-4).

2.6 SECONDARY FLIGHT OBJECTIVE ACCOMPLISHMENT

The requirement and definition of the Secondary Flight Objectives (SFO) identified prior to the launch of 1207 are provided in Annex H to the System Test Objectives (STO).

2.6.1 New SFOs

During the mission, two new objectives were defined:

B. SUN Photography

Exercise a direct solar photography experiment to determine camera and film degradation. The experiment will be run at the end of the RV-4 segment.

2.6.2 Early Rev Activity

All primary and redundant system testing was completed as planned by Rev 27.

2.6.3 SFO Accomplishment

A. SV Shroud Separation Dynamics

Conducted during ascent.

B. Reaction Control Subsystem Evaluation

Continued on RCS-1 until the transfer to RCS-2 on Day 90. Additional tests on RCS-1 were conducted during Solo.

C. Orbit Adjust Subsystem Evaluation

Conducted throughout the mission segments. A daily ambient OA and a long burn to determine engine washout characteristics was accomplished during Solo.

D. Electrical Subsystem Rev Status Determination

Conducted after each of the 5 RV recoveries.

E. T&T Redundant Equipment Evaluation

SGLS-2 tested weekly during the mission.

F. Lifeboat Magnetometer Calibration

Tests were conducted routinely during the mission.

G. Lifeboat Health Check

The check was satisfactorily conducted on Rev 18 as part of the early rev activities.

H. Horizon Sensor Noise Evaluation

Full rev recordings were made early in the mission on Revs 124/125 and 140/141. These recordings were repeated over the span from Revs 1525 to 1527.

I. RCS, EDAP, and Thermal Weekly Performance Check

Performed weekly.

J. Electrical System Rev Status Determination

Performed on each rev.

K. SGLS Signal Strength

Data was collected on a programmed basis from each remote tracking station.

L. Panoramic Camera Photographic Operations

All planned photographic engineering was completed except for Test 6.

M. Panoramic Camera Thermal Evaluation

Thermal data was collected and evaluated daily throughout the mission.

N. Panoramic Camera NCVU Operation

Planned but not conducted by SPO direction.

O. RV-1 thru RV-4 Thermal Record

Conducted in a quiescent mode on Rev 125 and with a Panoramic Camera operating on Rev 162.

P. Stellar Terrain BAR XC MOPs

MOPs were executed on Revs 113, 405, and 632.

Q. Stellar Terrain Calibration

The ST calibration was successfully executed on Revs 935/936.

R. Stellar Terrain Type 3414 Film Test

Three operates using 3414 were successfully conducted on Revs 932, 933, and 934.

S. K-Value Monitoring and Reporting

K-Value monitoring continued until the end of the ST Mission on Rev 942.

T. INDI Commanding

Commanding at INDI was exercised weekly.

X. SUN Photography

A direct solar photography experiment was conducted on Rev 1650 using MONO A.

2.7 SOLO AND DEBOOST

Limited Solo testing started after completion of the ST mission on Rev 942. ST tests were restricted to prevent the possibility of ejecting the remaining Terrain or Stellar film. Full Solo testing started after completion of the primary mission with the recovery of RV-4 on Rev 1656.

All planned Solo tests were completed except for Lifeboat Execute, which could not be done on the deboost rev; and the ST Terrain Shutter reset, which was prevented by the Emergency Terrain Thermal Shutter failure. The active phase was extended at the request of the Program Office to include additional performance evaluation of RCS-1. This activity continued until the successful deboost on Rev 1998 (Day 124). Solo test activity is presented in Table 2-1.

2.8 COMMAND LOAD SUMMARY

The software configuration used to support this mission was 'TUNITY MOD 2. The system software was MOD 13.1F. A nominal one rev load cycle for the payload revs was used throughout the mission. A total of 1,087 command messages were generated during the flight of which 924 were loaded into the vehicle.

TABLE 2-1

SOLO CHRONOLOGY

Rev or Span		Event
	— RV-5 Recovery, Rev 942 —	
959	OPS-1(o)	DBS Redundant Oscillator
	OPS-1(n)	DBS Redundant Heater
963	-	DBS Off
	— RV-3 Recovery, Rev 1039 —	
1052	-	DBS On-APL Checkout
1364	OPS-1 (l)	Redundant TCEA
1473-1474	OPS-1(h,i,j)	Redundant Heaters
1477	OPS-1(g)	MCS/LB/SGLS-2 (includes OPS-1, a,b)
1494	OPS-1(d)	Backup Timer
1525-1527	ACS-1	Horizon Sensor Mapping
	RCS-1	RCS Pulse Count
1603	OPS-1(j)	Primary OA Tank Heaters
1638	ST-1	Emergency Terrain Shutter
	ST-2	Stellar Safety Shutters
	— RV-4 Recovery, Rev 1656 (Start Full Solo) —	
1660	OPS-1(q,r,s,t)	ST Redundant Electronics
	ST-1A	Terrain Shutter Redundant Electronics
	ST-3A	ST Calibrate Shutdown
1662	OPS-1(m)	SCC No. 1 Select
	ST-1	Thermal Shutter
1664-1666	ACS-2	Gyro Drift Test

TABLE 2-1 (CONT'D)

Rev or Span		Event
1670-1671	ACS-5	Roll Maneuver Tests
1680	ACS-4	Solar Array Dynamics
1684-end	OAS-1	Daily OA to Evaluate Engine
1686	ST-4	Alternating ST Exposure
1692	THERM-1	-Y Thermal Exposure
1697	THERM-1	+Y Thermal Exposure
	(SS-2)	Pan Camera Dark Space Thermal
	ST-1	ST Emergency Shutters
1703-1704	ST-7	ST Two Rev Continuous Operation
1708	THERM-1	-X Thermal Exposure
1712	THERM-1	+X Thermal Exposure
1724	THERM-1	-Z Thermal Exposure
1728	THERM-1	+Z Thermal Exposure
1735-1736	RCS-3M	Quiescent Pulse Count
1737-1839	ACS-3	Arm Thermal Profile
1738-1739	RCS-3N	Quiescent Pulse Count
1740-1990	TTC-1	TTC Life Cycle Test
1751-1752	RCS-3O	Quiescent Pulse Count
1765	RCS-3P	RCS-1 Gyrocompass (Modified)
1767	RCS-3Q	RCS-1 Gyrocompass (Modified)
1800-1801	RCS-3C	RCS-1 Evaluation, Mono A
	RCS-3A	RCS-1 Evaluation, Mono B
	RCS-3B	RCS-1 Evaluation, Stereo
1816	RCS-3D	RCS-1 Yaw Test
1833	RCS-3E	RCS-1 Pitch-down Test
1844	RCS-3F	RCS-1 Gyrocompass Reverse
1846	RCS-3G	RCS-1 Gyrocompass Forward
1864	RCS-3H	RCS-1 Reverse (Pitch/Roll)
1866	RCS-3I	RCS-1 Forward (Inertial/Roll)
1881	RCS-3J	RCS-1 Fly Yaw Through Perigee

TABLE 2-1 (CONT'D)

Rev or Span		Event
1930	RCS-3L	RCS-1 Fly Pitch Through Perigee
1940	OPS-1(e)	SW Bus to LB Batt
[redacted]		
1997	-	Yaw Reverse
1998	-	Deboost

2.9 ANOMALY SUMMARY

Significant anomalies are listed chronologically in Table 2-2. The list includes a brief description of the anomaly and its effects on the mission. A more detailed discussion of these anomalies can be obtained in this report under the referenced paragraphs.

TABLE 2-2

SUMMARY OF ANOMALIES

DAY	DESCRIPTION	IMPACT	REFERENCE PARAGRAPH
15	Solar Array Leg 1 reduced output by 1/2 panel on Rev 232.	No mission impact. Attributed to break in solder connection. Jumper wires added to SV-8 and up.	3.6.1
18	Forward Camera metering capstan resonance at peak Vx/h.	RV-1 PFA identified problem. Perigee raised 2 NM on Rev 289.	4.1.2
31	Solar Array Leg 2 reduced output by 1 panel on Rev 495.	No mission impact. Similar to Solar Array Leg 1 incident.	3.6.1
58	Light leak in Stellar chute section of MCM.	Superimposed image. Cause unknown. Will increase inspection and sealing.	2.5.5
65	Aft Film tear on Op 304.	RV-3 PFA identified. No mission impact. Cause of tear unknown.	4.1.1
89	Horizon Sensor Inhibit as result of incomplete yaw reverse. Failure to VBE allowed OA to occur.	OA-38 only partially effective. OA-39 needed to lower perigee on Rev 1447. See reference paragraph.	3.2.6
103	RV-4 missing one VHF Antenna.	No loss in data. Reason and time of loss unknown. No action contemplated.	5.3
103	RV-4 Main Battery vented electrolyte during shipment.	No mission impact. Corrective action being taken.	5.3

SECTION III

SATELLITE BASIC ASSEMBLY SUBSYSTEMS

3.1 INTRODUCTION

The following paragraphs summarize those requirements from the Satellite Basic Assembly (SBA) subsystems that could be verified from flight data.

3.2 ATTITUDE CONTROL SYSTEM (ACS)

The ACS performed as expected with the exception of a yaw maneuver attempted with low force level thrusters, see paragraph 3.2.6.

3.2.1 BV/SV Separation

BV/SV separation was completed at approximately 534.5 seconds vehicle time; the vehicle time started 67.21 seconds prior to lift-off. Master Clear Off, which enables the pitch, roll, and yaw integrators to accumulate angle, was at 510.8 seconds. SECO, which terminates BV attitude control, occurred at 522.5 seconds vehicle time. The SV attitude changes from SECO to BV/SV separation. The attitude and rates as measured at BV/SV separation are shown in Table 3-1. This table also presents the times in which the SV attitudes and rates came back within the specified limits following BV/SV separation (capture).

3.2.2 Subsatellite/SV Separation

The Subsatellite/SV separation events of Rev 13 were as follows:

Event	Vehicle Time (seconds)
Start Negative Yaw Maneuver	70220.4
Stop Yaw	70253.8
Separation	70313.6
Start Positive Yaw Maneuver	70330.8
Stop Yaw	70364.2

The ACS parameters just prior to the instant of separation (70313.6 seconds vehicle time) are presented in Table 3-2.

TABLE 3-1

BOOSTER VEHICLE/SATELLITE VEHICLE (BV/SV) SEPARATION

	RATE AND ATTITUDE AT BV/SV SEPARATION						CAPTURE			
	RATE (degrees/second)		ATTITUDE (degrees) HS @ SEPARATION		ATTITUDE (degrees) Δ(SECO - SEPARATION)		ATTITUDE		RATE	
Axes	Specified (deg/sec)	Actual (seconds)	Specified (degrees)	Actual (seconds)	Specified (degrees)	Actual[5] HS/Integrator	Specified[1] (degrees)	Actual[2] (seconds)	Specified[3] (deg/sec)	Actual[4] (seconds)
Pitch	±.752	-.109	13.0 to -21.7	.77	±3.5	-.01 to -.52	±.70		±.014	
Roll	±.786	-.193	±10.6	3.92	±3.5	1.12 to 1.81	±.70	SEE NOTE 6	±.021	SEE NOTE 6
Yaw	±.752	.131	11.1 to -11.4	-	4.5 to -3.5	-/ 3.46	±.64		±.014	

NOTES:
[1] Attitude in degrees to be achieved in 1500 seconds.
[2] Actual time required to achieve specified attitude (switch to fine mode + settling time).
[3] Rate in degrees/second to be achieved in 1500 seconds.
[4] Actual time required to achieve specified rate.
[5] Relative to the local horizontal.
[6] Nominal performance, indicating pointing requirements are satisfied, was observed at a nominal settling time of 520 seconds after the commanded switch to fine mode (672 seconds after separation). The total 1192 seconds is well within the spec of 1500 seconds and no closer study was performed.

TABLE 3-2

RATE AND ATTITUDE PARAMETERS AT SUBSATELLITE SEPARATION

Parameter	Specified	Actual
Pitch H/S	±1.0 deg	.23 deg
Roll H/S	±1.0 deg	-.70 deg
Roll Integrator	-	-.17 deg
Yaw Integrator	-	-.14 deg
Pitch Integrator	-	.29 deg
Yaw Attitude	(-23.5 deg desired)	
Pitch Gyro Rate*	±0.1 deg/sec	-.06 deg/sec
Roll Gyro Rate	±0.1 deg/sec	.03 deg/sec
Yaw Gyro Rate	±0.1 deg/sec	0
Maximum rates following separation:		
Pitch Gyro Rate*		-.09 deg/sec
Roll Gyro Rate		.21 deg/sec
Yaw Gyro Rate		.08 deg/sec

NOTE: The asterisk (*) denotes that the Geocentric Program rate is connected.

3.2.3 Payload Operations

3.2.4 Mapping Camera Module (MCM) Operations

3.2.4.1 MCM Calibration Maneuvers

The calibration maneuver on Rev 936 consisted of yawing the SV 180°, then pitching down 142°, followed by an inertial period for the calibration. Geocentric rate was then connected and disconnected an additional time to provide a total of two pitch attitudes for MCM calibrations. The second pitch attitude was 154.1 degrees. The vehicle was pitched back to local horizontal and yawed 180° to nose forward geocentric control. The pitch attitude as measured with the H/S upon returning to nose forward horizontal flight was -.56°, indicating successful execution of the calibration sequence.

The settling time for Calibration 1, the time from initiation of the pitch-down maneuver to the start of Frame 001, was 339.3 seconds. The settling time for Calibration 2, the time from the removal of geocentric rate to the start of Frame 001, was 11.6 seconds. Settling times were well within the 600 seconds allowable.

3.2.4.2 MCM Recovery

RV-5 recovery is performed with the SV yawed 180° and pitched-down, with the release taking place along the SV X-axis. Vehicle rate and attitude parameters at RV-5 separation were nominal. RV-5 was separated on Rev 942 at vehicle time 825231.8.

3.2.5 Recovery

The pitch-down maneuvers preceding RV-1 thru RV-4 separations were all within specification. The RV separation performance summary is shown in Table 3-3. It appears that the RV-4 separation impulse may have been in excess of the 166 lbs/second specification limit.

~~TOP SECRET-HEXAGON~~

TABLE 3-3

SUMMARY OF RE-ENTRY VEHICLE/SATELLITE VEHICLE SEPARATION PERFORMANCE

RV/Rev	Peak Pitch Rate (deg/sec)	Max. Pitch Integrator Angle (degrees)	Induced Impulse By Rev (lbs/sec)	Pitch-Down Prior to Sep (degrees)	Pitch-Up Following RV Sep to Removal of Maneuver Command (degrees)	Pitch Inertia (After Sep) (slug-ft^2)	Pitch Thruster Moment Arm (feet)	Roll Spec (degrees)	Angle Meas H/S (degrees)
1/229	1.39	5.2	129	-33.8	98.3	143112	16.4	±1.0	-.06
2/602	1.37	5.6	133	-37.5	100.1	121872	15.9	±1.0	-.20
3/1039	1.51	8.4	140	-40.6	99.4	93916	14.6	±1.0	-.08
4/1656	1.40	9.2	169	-37.4	35.7	84455	14.5	±1.0	.12

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3.2.6 Unsuccessful Yaw Maneuver for OA-38

Although the thrust of Reaction Engine Assembly (REA) 1 had reached a value below that recommended by SBAC for continued use, the vehicle was still being controlled within specification. In the desire to extend the use of RCS-1 to the maximum and since no danger to the vehicle was involved, it was decided to execute the yaw-around maneuver for a negative OA (OA-38). Because of low reaction control system thrust levels (1 lb to 2.2 lbs vice the nominal of 5 lbs), it was decided to perform the yaw-around maneuver in the gyrocompass to fly nose aft mode. Although this method of maneuvering requires much more time to complete (approximately 5,400 seconds), it was felt that using the degraded thrusters in the pulsing mode would be better on thruster health than the "full-on" usage required to achieve a nominal maneuver rate of .7 degrees/second as in the standard yaw maneuver.

Due to the insufficient time allowed to perform the gyrocompass maneuver in the coarse mode, the vehicle roll attitude error increased beyond the roll horizon scanner field-of-view causing the horizon scanner to inhibit and the vehicle to subsequently tumble. At Rev 1442 Pogo, the Roll Horizon Sensor (H/S) outputs were observed to be inhibited on both PACS and RACS. The continued presence of the pitch H/S output indicated a single head inhibit had occurred.

Attempts to Variable Block Erase (VBE) the negative OA and subsequent yaw forward failed. These commands were in PMU A, whereas VBE of PMU B was executed. There was insufficient time remaining before station fade out to send VBE of PMU A.

On Rev 1443 Pogo following the negative OA and yaw forward, the vehicle was stable and flying nose forward (no H/S inhibit). Evaluation of playback data from Rev 1442 Pogo, which was recorded on Rev 1441, showed that the H/S inhibit occurred during the fine mode portion of the yaw reverse. Due to the longer than anticipated time to reach the gyrocompassing coast rate of .19 degree/second (coarse mode PWM saturation limit), the 2,500 second coarse mode gyrocompassing period was insufficient to complete the major portion of the 180° maneuver. The observed time to reach coast rate (2,200 seconds) was approximately 600 seconds longer than expected from previous analyses. Since the time to reach coast rate is dependent upon the magnitude of the initial error, it is uncertain as to whether the unexpectedly long time to reach coast rate was because of a small initial error, or a combination of low and unbalanced thrust levels from RCS-1.

When the ACS was switched from coarse to fine mode, the roll gyro was sensing an orbital rate component of approximately -.06 degree/second. This is beyond the .021 degree/second PWM saturation limit in fine mode. Thus, the SV roll attitude increased in a positive direction until H/S inhibit occurred (approximately 12°) resulting in a tumble. Subsequent orbit evaluation revealed an approximate vehicle attitude of -28.7° in pitch and 148° in yaw at the time of the OA burn.

After OA-38, while the SV was gyrocompassing back to nose forward attitude, the H/S re-acquired the earth and completed the gyrocompassing maneuver within the expected time. The direction of yaw for the return was in the negative direction. The direction of gyrocompassing is dependent upon the polarity of the initial error signal. Following this maneuver, the vehicle was in the normal nose forward attitude at Rev 1443 Pogo. An M1V1-to-M2V2 transfer was executed on Rev 1447 with M1 remaining "on".

As a result of the evaluation of this anomaly, no changes are contemplated in the vehicle. Time for the coarse mode portion of any future use of this maneuver will be selected utilizing the results of this study. The ACS operation was normal.

3.3 REACTION CONTROL SYSTEM (RCS)

3.3.1 Flight Summary

SV-7 was the first vehicle to operate with a complete set of soft seat valves for the thrusters. Propellant for the RCS was drawn only from the small RCS tanks for the first 1,013 revs. With the hard seat valves used on SV-1 thru SV-6, it was shown that non-volatile residue (NVR) from fuel stored in the RCS tanks would eventually cause the valves to leak. No leaks were observed on SV-7. On Rev 1013, Isolation Valve 2 was opened connecting RCS Tanks 1 and 2 (Tanks 3 and 4 were not installed) to the OA Tank and RCS propellant was drawn directly from the OA Tank.

The primary Reaction Control System (RCS-1) was used through Rev 1449 (Day 90) when control was switched to the standby system (RCS-2). Switch to RCS-2 was occasioned by the unsuccessful yaw maneuver discussed in paragraph 3.2.6. RCS-2 performed nominally throughout the remainder of the active mission.

The REA and REM temperatures have been closely watched in the past to signal RCS leaks. The temperature levels for SV-7 remained relatively constant throughout the flight.

3.3.2 Propellant Consumption

Since SV-7 was the first vehicle to be operating off the small RCS tanks, it was possible for the first time to get an accurate average daily consumption rate. Over the first 1,000 revs, propellant consumption averaged 2.6 lbs/day. It is estimated from the less accurate measurements when the OA Tank was connected that the rate remained constant until the Solo operation when the duty cycle changed.

3.3.3 Thruster Performance

Thrust levels for RCS-1 were determined using the individual REA chamber pressures with the exception of REA-1 where thrust was determined from gyro data. Figure 3-1 is a plot of the normalized thrust over the mission life. The dashed lines are the $\pm 8\%$ run-to-run specification limits. As can be seen, all of the yaw thrusters and the two low activity pitch roll thrusters degraded while the active thrusters (3 and 7) remained healthy throughout flight. All REA duty cycles were slightly lower than previously experienced.

NORMALIZED THRUST HISTORY

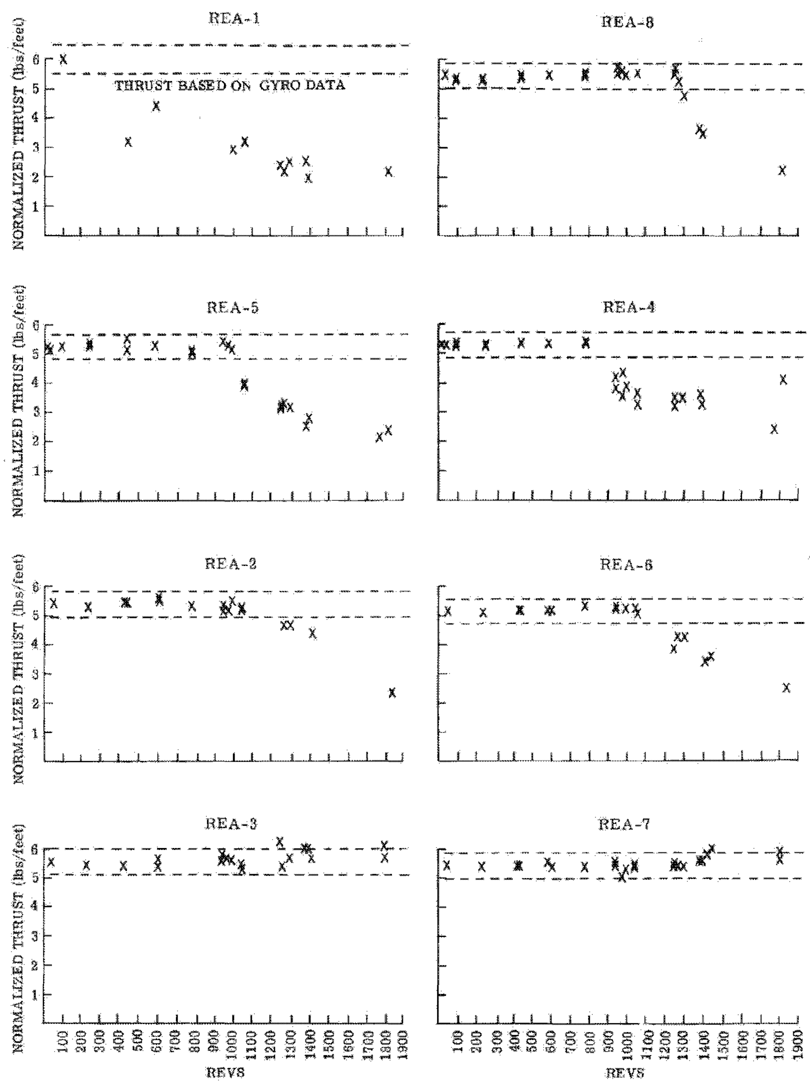

FIGURE 3-1

Total pulse count for RCS-1 thru Rev 1449 is shown in Figure 3-2. The method used to determine pulse count was checked during Solo by comparing continuous record sequences with the sampling system used for Figure 3-2. For the high duty REAs (3 and 7), the accuracy is $\pm 30\%$; for the other thrusters, the technique does not give an accurate count and can only be used to verify the thruster has a low duty cycle. RCS-1 was again activated on Rev 1740. Health tests were conducted to determine if the degraded thrusters of RCS-1 could perform critical vehicle maneuvers while operating at low feed pressures. All attempted maneuvers were successfully accomplished. During this period of Solo operation, RCS-2 was brought on line each evening to minimize the possibility of operational problems. RCS-2 was operated for control during the deboost event.

3.4 ORBIT ADJUST SYSTEM (OAS)

3.4.1 Orbit Control

The OAS was utilized 43 times during the active mission and 21 times during the Solo phase. A large number of starts were purposely planned during Solo to investigate the life capability of the OA engine.

The OA firings were all normal and engine performance was well within specifications. Because of the uncompleted yaw reverse maneuver, the vehicle was yawed 148° and pitched -28.7° at the time of burn for OA-38. This resulted in a ΔV of -17.15 feet/second along the vehicle X-axis, which was within 4% of that planned.

The catalyst bed pressure drop exhibited an early gradual decline; however, it subsequently stabilized at approximately 15 lbs/inch.

3.4.2 Deboost

The deboost was successfully accomplished with five engine pulses, OAs 59 thru 63. This consisted of four 74 second firings and one 215 second firing with off-times of 5 seconds between firings. The firing duration was 515 seconds to achieve a planned negative velocity increment of 188 feet/second. A sixth firing was programmed for 180 seconds to bring about propellant depletion; depletion was observed at approximately 85 seconds into this burn. The engine performance during all burns was nominal.

3.5 LIFEBOAT II SYSTEM

3.5.1 Bay 10 Battery Induced Errors

Again for this flight, two Type 29 Batteries were installed in Bay 10 adjacent to the Lifeboat Magnetometers in Bay 9. These batteries introduced magnetometer errors. Therefore, a calibration test was run on Rev 52. The following are the results of this calibration test:

A. Telemetry bias on both D201 and D202 channels is 0 to 1.5 milligauss; therefore, no correction of data for telemetry bias was required.

B. Induced magnetism errors are similar to those on SV-5 and SV-6 and based on the errors encountered, it was concluded that the Lifeboat System could still operate within its attitude specification.

THRUSTER PULSE COUNT HISTORY

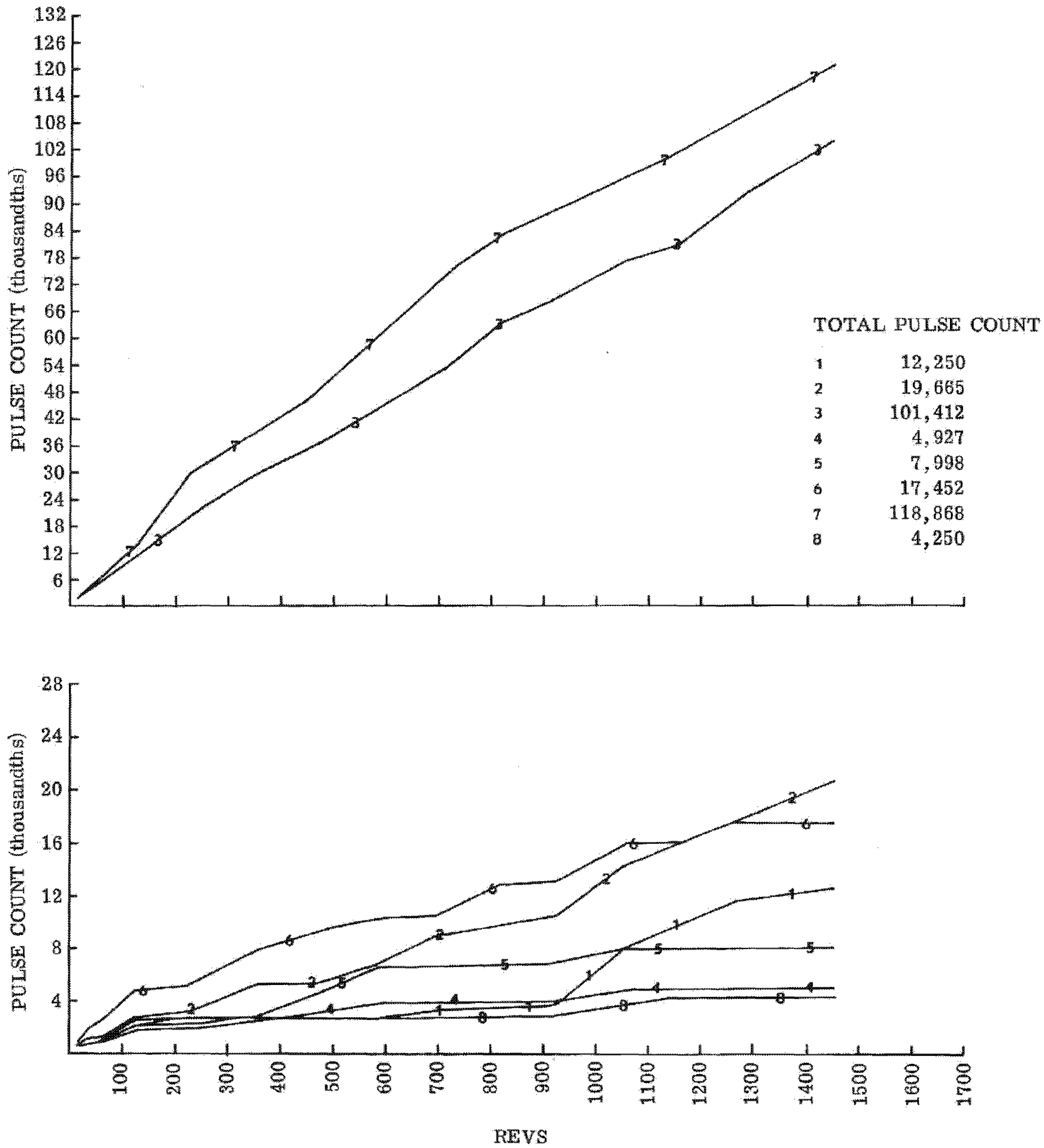

FIGURE 3-2

Additional confirmation of Lifeboat capability was obtained during recoveries when magnetometer readings indicated errors of less than .5° in pitch and yaw for RV-1 and less than 1° for RV-4. These values are well within the allocated error of 2.5 degrees.

3.5.2 Yaw Attitude Determination

Periodic yaw attitude determination tests were performed throughout the mission. These tests are performed as a backup in the event of an ACS malfunction. Since an error of 1° yaw would result in a 6 milligauss change in the ΔQ magnetometer, a 1° error would be difficult to detect without establishing the magnetometer distortion error while ACS control is normal.

Based on these same tests, errors of 0° to 1° in yaw and 1° in pitch would be expected if Lifeboat were used to deboost.

3.6 ELECTRICAL DISTRIBUTION AND POWER (EDAP)

3.6.1 Solar Arrays

Solar arrays were extended on Rev 1. Power output from each leg exceeded the specification value. Degradation from normal orbit environments was 4.7% after 103 (1,656 revs) days. However, an anomaly occurred on Leg 1 (Rev 232) which reduced the output by 1/2 panel for approximately 15 minutes during the illuminated period. Solar Array Leg 2 exhibited a similar problem on Rev 495 reducing the output by 1 panel for 7 minutes during the illuminated period. The reduced output time for both legs increased each week of flight until Rev 1266 when the reduction extended throughout the illuminated period. This power loss did not compromise the mission objectives since the generated power continued to be greater than the power used.

The fault was traced to a change in solder on the connecting boards. This more-brittle solder, which is more susceptible to thermal fluctuations, led to the separation between the trace and post connector. All future solar array connectors have jumper wires installed in addition to the traces, which should eliminate this problem on future flights.

3.6.2 Main Bus Voltage

The main bus voltage varied from a low of 25.9 to a high of 31.5 volts. The allowable range is 25.5 to 33 volts. Low range voltage was obtained during payload operations with a bus load of 51 amps. High voltage data was gathered during charge cycles.

3.6.3 Power Capability and Usage

Power usage ranged from 313 to 412 amp-hours/day. The 412 amp-hours/day exceeded the 390 calculated amp-hours/day capability. K2 cutoffs did occur during this period indicating the generating capability exceeded 390 amp-hours/day when loaded heavily. Excess capacity was demonstrated with K2s occurring on Rev 3 and then on random revs up to Rev 28, after which K2s occurred essentially on every rev except those with heavy payload operations.

3.6.4 Type 29 Main Battery Performance

All Type 29 Batteries operated normally and in a desirable environment (44°F to 50°F) throughout the mission. The main battery (No. 4) heater experienced abnormal cycling patterns during Revs 186-306, 345, 511, and 512. The only noticeable effect was a rise in temperature from 46°F to 48°F. Abnormal cycling of the heater was also observed on Battery 3 on Revs 333, 334, and 335. The temperature of the primary batteries, which are in the same bays, rose about 2°F. These heater anomalies are similar to those observed on SV-6. A solid state thermal control device, replacing the present thermostats, will be incorporated starting with SV-11. In the interim, additional testing has been introduced to screen out malfunctioning thermostats.

3.6.5 Pyro Battery Performance

Pyro Battery 1 stabilized at 49°F to 50°F, which minimizes self discharge during the mission. Lift-off capacity was 11.194 amp-hours. After 103 days, the usage for instrumentation and self discharge was 5.22 amp-hours leaving a residual capacity of 5.97 amp-hours. Cell degradation life at completion of the primary mission (Day 103) was 21 days. Pyro Battery 2 followed the same pattern.

3.6.6 Lifeboat Battery Performance

The Lifeboat battery operated normally in a 48°F to 49°F environment throughout the entire mission. A total of 214 of the 351 amp-hours at launch remained at the end of 103 mission days. Cell degradation life at the completion of the primary mission was 23 days.

3.7 TRACKING, TELEMETRY, AND COMMAND (TT & C)

3.7.1 Tracking

There were four reported data losses on SV-7 that have been attributed to new antenna pattern "holes". The principal characteristics of the station passes during which the data losses occurred are summarized in Table 3-4.

TABLE 3-4

SUMMARY OF STATION PASS CHARACTERISTICS WHEN DATA LOST

Pass	RTS	Vehicle Side	Maximum Elevation (degrees)	Antenna Used (feet)	Range at Maximum Elevation (NM)	Elevation Angle of Loss (degrees)	Duration of Loss (seconds)
125	GUAM	Right	67	60	158	59A to 46D	37
146	COOK	Left	63	60	125	41D to 29D	20
154	COOK	Right	60	46	151	54D to 45D	16
1208	COOK	Left	68	46	136	40A	2

NOTE: The A or D codes in the elevation angle of loss column refer to whether the elevation angle is ascending or descending from the maximum elevation angle.

In the first three instances, real time data was lost. At 1208 COOK, only tape recorder playback data on the 1.7 MHz subcarrier was lost.

Review of signal strength data from several passes having similar characteristics but with no data dropouts revealed rapid and high fluctuations of signal strength at high elevation angles. It is therefore concluded that the data losses were due to new, very small area holes in the antenna pattern. The 2 second loss of tape recorder data on Pass 1208 COOK coincided with a signal decrease of 31 dBm and a return to the previous signal strength level of -84 dBm within two seconds.

Although it is probable that the initial loss of data is due to the antenna holes, the duration of the data loss is influenced by the ability of the RTS to re-acquire the downlink signal once it is realized that the loss has occurred.

3.7.2 Telemetry

3.7.2.1 General Performance

Telemetry System performance was satisfactory throughout the flight. PCM Side 1 was utilized on all active station contacts except Revs 9 and 18 when PCM Side 2 was checked. SGLS-1 was utilized on all active station contacts except for periodic checks of SGLS-2 on Revs 9, 18, 130, 243, 373, 471, 584, 697, 811, 924, 1054, 1151, 1265, 1378, 1477, 1492, and 1606. Operation of both SGLS links was satisfactory, except as noted in paragraph 3.7.1. In addition, operation of the PCM System during tape recording and operation of Tape Recorders 1 and 2 was normal throughout the flight. Tape Recorder 2 was used satisfactorily on Revs 0 (ascent), 124, 125, 140, 141, 162, and 936 for read-in and Revs 2, 133, 149, 166, and 936 for read-out.

To gain data on the Tracking and Telemetry Subsystem performance for longer missions, the subsystem was exercised 50 times per revolution during Solo. This brought the total number of subsystem on/off cycles from 12,000 to approximately 21,000, the number estimated for a 180 day mission. All equipment performed satisfactorily.

3.7.2.2 Instrumentation

Table 3-5 presents the instrumentation anomalies at lift-off.

TABLE 3-5

INSTRUMENTATION ANOMALIES AT LIFT-OFF

Identification No.	Item	Description
B001	Primary REA Chamber Pressure Monitor	Inoperative due to defective transducer.
B053	Thruster 3 Temperature Monitor	Erratically indicated incorrect temperature, usually 80° high.
B242	Lifeboat Regulator Valve Close Monitor	Will occasionally indicate a "1" (closed) with the Regulator Valve open and gas flowing. This is an instrumentation anomaly.

3.7.3 Command

3.7.3.1 General

The vehicle SGLS command equipment was utilized to receive more than 20 million bits with no vehicle problem indications.

3.7.3.2 GFE Command System

A. Extended Command System (ECS)

The ECS responded satisfactorily in all command modes resulting in the loading of 249,965 Stored Program Commands (SPCs) in memory. Of the SPCs loaded, 110,539 were output by both PMUs for decoder processing. The remainder were erased prior to their time label matches. In loading the 249,965 SPCs, there were no command rejects attributable to the ECS.

B. Minimal Command Subsystem (MCS)

The MCS responded correctly to all commanding.

C. Remote Decoder/Backup Decoder

Both sides of the Remote Decoder were used for each of the five recoveries. Performance of both sides was determined to be acceptable through analysis of telemetry data.

D. Command System Usage Summary

Table 3-6 presents a summary of the command system usage thru Rev 1656.

TABLE 3-6

COMMAND SYSTEM USAGE

(hours)

System	Total Operating Time
ECS	2432.6
MCS	10.4
Remote Decoder	2.6
Backup Decoder	0.1

3.7.3.3 375 MHz Receiver

The 375 MHz Receiver was powered during the entire mission with no anomalies.

3.7.3.4 Data Interface Unit (DIU)

The Data Interface Unit performed satisfactorily throughout the flight.

3.8 MASS PROPERTIES

The vehicle weight history is presented in Table 3-7.

TABLE 3-7

VEHICLE WEIGHT HISTORY

(pounds)

Event	Weight
Prelaunch Weight	24,958
After Sub-Sat Eject	21,423
Prior to RV-1 Separation	21,079
After RV-1 Separation	19,529
Prior to RV-2 Separation	18,821
After RV-2 Separation	17,329
Prior to RV-5 Separation	16,914
After RV-5 Separation	16,518
Prior to RV-3 Separation	16,259
After RV-3 Separation	14,714
Prior to RV-4 Separation	13,894
After RV-4 Separation	12,463
Prior to Deboost	11,946

3.9 SOLAR ARRAY (SA)

Deployment and erection time histories for the solar arrays were nominal. The arrays were deployed at the first station pass (INDI) and were repositioned from 18° to 0° at KODI on Rev 1 for maximum output at the flight beta angle of 0 degrees.

3.10 THERMAL CONTROL

3.10.1 Mid and Forward-sections Including MCM

Flight data indicates that the thermal design of these sections provided the required orbital temperature control. No design changes are programmed as a result of SV-7 flight performance.

3.10.2 Active Thermal Control (ATC)

The reference temperature, T_{REF}, for the Mid-section film path ATC remained relatively constant for the first three segments of the mission and then experienced a gradual cooling of approximately 3°F during 1207-4. The rate of change in T_{REF} is approximately the same as the rate observed on SV-5. The RV heater control zones, which are actively controlled relative to T_{REF}, were generally within 1°F of T_{REF}. The reason for this cooling has not yet been determined.

3.10.3 Aft-section

Acceptable Aft-section temperature control was maintained throughout the flight. All equipment temperatures remained within design limits.

The SV-7 Aft-section was configured as follows:

A. The external paint pattern and the battery and ARM modules are configured the same as on SV-5 and SV-6.

B. The forward web of the RCS has been replaced with a truss network (block change).

C. RCS Tanks 3 and 4 in Bays 5 and 7 have been removed.

Equipment and structural temperatures indicated contamination degradation to external vehicle thermal control surfaces similar to that noted after all other flights. The amount of degradation was within the bounds of preflight analysis.

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SECTION IV

PAYLOADS

4.1 SENSOR SUBSYSTEM

4.1.1 Camera Operations and Performance

Overall, Mission 1207 was a successful HEXAGON operation. The Sensor Subsystem (SS) performed very well and all of the film was transported with good tracking characteristics and was recovered without significant damage.

A film tear on one Aft frame in RV-3 (Op 304) did not adversely affect performance. Film path telemetry data and image analysis indicated that the tear had most probably occurred after exposure. Subsequent analysis established the most probable cause as ingestion of a connector dust cap in the Take-up area. There were no repeats of this anomaly.

Both fine film paths performed nominally throughout the mission except for a resonance exhibited by the Forward Camera metering capstan at peak Vx/h values of the original orbit. The corrective action taken was modifying the orbit by raising the perigee altitude 2 NM on Rev 289 to avoid the troublesome region. Operation was nominal thereafter. In addition to the 1414 Film, 1207 included approximately 5,000' of SO-255 Color Film, and 500' of FE-3916 Infrared Color Film on the Aft Camera. This is the second HEXAGON mission to attempt infrared color photography, and the first to do so successfully. Mission 1207 is the first of the Block II series of HEXAGON Camera Systems, which incorporates an Interchangeable Filter (ICF) capability.

4.1.2 Camera Data

The Panoramic Camera data for 1207 is summarized in Table 4-1.

TABLE 4-1

CAMERA STATISTICS

Parameter	Forward Camera	Aft Camera
Camera Designation	A	B
Film	1414	1414/SO-255/FE-3916
Focal Length (inches)	59,9917	59,9680
Equivalent Filter Type	W-12/W-2E3	W-12/W-2E3
Initial Focus Setting (microns)	137	33/63
Supply Footage (feet)	107,426	100,406/4984/501
Supply Spool No.	2331	2470
Supply Film Weight (lbs)	850.1	853.7

TABLE 4-1 (CONT'D)

Parameter	Forward Camera		Aft Camera
Optical Set Numbers	031		038
Initial Pneumatics (lbs)		34.0	
Estimated Remaining Pneumatics (lbs)		4.5	

It should be noted that the focus was not changed on either camera.

4.1.3 Camera Operations

The mission was active for 103 days, the longest HEXAGON mission to date. The SS had the following constraints on its operation to preclude mistracking:

A. No rewinds greater than 5 inches/second.

B. No 30° scan mode operations at ±45° scan centers.

These constraints are now considered standard for future HEXAGON missions.

Film footage for each camera and mission segment is broken down by each 15° segment, see Table 4-2. The number of frames for each camera and mission segment acquired in each of the four scan modes is given in Table 4-3.

TABLE 4-2

DISTRIBUTION OF FILM FOOTAGE PER SCAN SECTOR

(feet)

Mission Segment	Camera	Scan Sector (degrees) -60 to -45	-45 to -30	-30 to -15	-15 to 0	0 to 15	15 to 30	30 to 45	45 to 60
1207-1	Fwd	946	2602	3355	3570	3634	3312	2817	1269
	Aft	831	2452	3202	3424	3465	3141	2634	1114
1207-2	Fwd	1025	2714	3217	3679	3498	2935	2332	744
	Aft	1025	2714	3217	3679	3498	2935	2332	744
1207-3	Fwd	530	3023	3707	3950	3884	3442	2913	618
	Aft	530	3023	3707	3950	3884	3442	2913	618
1207-4	Fwd	318	2368	3116	3052	2734	2321	1764	207
	Aft	317	2360	3104	3056	2740	2312	1758	190

TABLE 4-3

DISTRIBUTION OF FRAMES PER SCAN MODE

(frames)

Mission Segment	Camera	Scan Mode (degrees) 30 (1M)	60 (2M)	90 (3M)	120 (4M)
1207-1	Forward	315	1019	1557	298
	Aft	315	1000	1534	206
1207-2	Forward	466	1557	1081	214
	Aft	466	1557	1081	214
1207-3	Forward	1109	1413	1354	108
	Aft	1109	1413	1354	108
1207-4	Forward	2194	1223	395	63
	Aft	2190	1223	395	56

The Input Drive Servo on the Forward Camera had a higher than normal summed error deviation during testing at both the east and west coasts. This anomaly did manifest itself on-orbit and resulted in a detectable disturbance (78 Hz). On the Aft Camera, during 1207-1 and 1207-4, an extraneous pulse toward the beginning of operation caused an early start resulting in two extra frames.

Prior to vehicle launch, EM data indicated that the Forward Camera Supply Seal Door was occasionally sticking to the film during initial transport start-up. This anomaly was verified via subsequent analysis of the affected film; however, the anomaly did not occur on-orbit and there was no impact on camera performance.

4.1.4 Photographic Image Quality

Photographic image quality was very good and essentially equivalent from both cameras. Mean 2:1 contrast VEM resolution performance was 155 ±15 cycles/mm, which is comparable to or better than previous winter missions. Peak VEM resolution was approximately 180 cycles/mm. The seven CORN tribars read ranged from 1.8' to 2.9' ground resolved distance. Single acquisitions on color and infrared color read 2.6' and 5.5' respectively. There was a consistent trend for in-track quality measurements to be slightly superior to cross-track. The 1207 tribar data normalized to 2:1 contrast is given in Table 4-4.

Although the PFA Team had been concerned about a possible degradation of image quality with successive RVs, an in-depth quality assessment revealed no significant losses with time into the mission. There was, however, a predominance of low sun angle photography during the latter half of the mission. Local weather and acquisition geometry rather than camera system performance as such continue to be the principle sources of quality degradation.

TABLE 4-4

CORN TRIBAR ACQUISITIONS NORMALIZED TO 2:1 CONTRAST

— Forward Camera —

Op	Frame	Scan Angle (degrees)	Field Angle (degrees)	GRD (feet) IT	GRD (feet) CT	GRD (feet) GM	RP (cycles/mm) IT	RP (cycles/mm) CT	RP (cycles/mm) GM
22	003	24	2.0	2.8	3.6	3.2	144	118	130
69	003	5	-1.3	2.3	2.9	2.6	158	125	141
186	004	2	-0.5	2.3	2.6	2.5	157	138	147
529	002	-21	-2.2	2.3	3.0	2.6	174	137	154
— Aft Camera —									
22	004	25	0.4	2.7	3.1	2.9	148	139	143
186	004	2	-2.5	2.4	3.6	2.9	150	101	123
529	003	-21	0.7	2.3	3.0	2.6	169	137	152

As with previous missions, an intermittent anomalous arching of the major axis quality (scan angle dependency) was observed and continues to be unexplained. A thorough analysis of this anomaly is in progress. The effective field curvature on-orbit was measured by VEM and found to be essentially flat, confirming the adequacy of the platen tilt settings. There was no loss in resolution detected in mission photography as compared to the comparable ground test data. This was an area of concern since, during Chamber A-1 testing, outgassing occurred which contaminated the camera optical surfaces. Resolution variability, however, was again more severe on-orbit (14%) than in Chamber A-2 (8%).

GAWA calculations have been discontinued. These calculations served their initial purpose of verifying CRYSPER performance prediction programming with mission image suitability for the photo-interpreter. Analyses are continuing in an attempt to relate mission parameters and photographic image quality to the National Image Interpretability Rating Scale (NIIRS) data.

4.1.5 Focus

Mission 1207 was launched with focus set at optimum. There were no changes made during the mission. VEM analysis input to the focus decision employed for the first time the new 25-step INSCAL-produced VEM matrix. Use of the old 8-step VEM matrices, which were used for gathering data from Missions 1201 thru 1206, is now discontinued. Cross calibration demonstrates data compatibility. Based on a subjective evaluation, the color photography was also at optimum focus.

4.1.6 Film Synchronization

Measured displacements in the smear slit imagery as compared to predicted displacements were used to assess the accuracy of image motion compensation (IMC). Launch settings made from ground test sync-flash data were within .01 inch/second mean smear residual error with the exception of the Aft Camera in-track. For this case, smear error was determined to be .032 inch/second and was corrected on Op 132 by commanding a minus (-) 3-step OOAA change.

The SO-255 Film on the Aft Camera was found to be too slow by .058 inch/second in the cross-track direction. Recommendations for future missions have been made based upon the Mission 1206 and 1207 color on-orbit tests.

The anticipated on-orbit variability of image motion was less than that measured, except for the Aft Camera in-track direction. The on-orbit measured variability was less than the original SV design budget. The Aft Camera in-track was .015 inch/second in excess of the budget.

4.1.7 Exposure

An exposure imbalance of .06 log E between the two cameras was corrected on Op 138 by reducing the Aft Camera by a two-count slit width bias. Microdensitometric analysis of mission photography revealed a slight overexposure (.05 log E) relative to the present 1.0 mean scene density aim criterion. However, a change to a 1.1 aim is recommended. Both color records appeared to have correct exposure.

Use of the new 3-step snow biasing technique showed a significant increase in the number of correctly biased snow surround frames over what would have resulted with the former single-step criterion. Analysis of sand surround frames indicated that the present desert polygon bias is sufficient when applied, but that modification of the application criteria may be required. Consistent with previous missions, analysis of vegetation surround frames indicates that domestic photography has larger scene log E ranges than denied area photography, and that the Forward Camera tends to produce larger ranges than the Aft.

4.1.8 Engineering Tests

Eleven engineering tests were defined in the Engineering Photography Plan. This series of tests was designed to acquire data for assessment of on-orbit camera, lens, and film performance. Table 4-5 presents a summary of objectives and status of each of the tests.

TABLE 4-5

SUMMARY OF ENGINEERING TESTS

Test	Objective	Status
1. Thru Focus (1414)	Optimize focus.	Accomplished; confirmed focus (1414) was optimum in RV-1.
2. Smear Slits (1414)	Validate IMC settings.	Accomplished; optimum biases determined in RV-1; implemented (Aft in-track) and confirmed in RV-2.
3. Smear Slits (SO-255)	Evaluate smear slit imagery for validating IMC settings with SO-255.	Completed in RV-1; no OOAA changes recommended.
4. CORN Acquisitions (SO-255)	Evaluate and radiometrically calibrate SO-255.	Completed in RV-1 with a single acquisition reading of 2.6' GRD.
5. CORN Acquisitions (FE-3916)	Evaluate image quality of FE-3916.	Completed in RV-3 with a single acquisition reading of 5.6' GRD.
6. Lens MTF (1414)	Measure on-orbit lens MTF.	Two acquisitions were accomplished but were not usable; test cancelled after RV-2 in favor of Test 11.
7. Tucson Acquisition	Standard scene for quality assessment.	Satisfied only for RV-1, RV-2, and RV-4.
8. Color Thru Focus (SO-255)	Optimize focus.	Accomplished in RV-1; confirmed that focus (SO-255) was optimum.
9. Tribars for Resolution	Photo quality assessment.	Satisfied only for RV-1, RV-2, and RV-4; acquisitions were in common with Test 7. Results indicate an average of 2.2' GRD (floating contrast) and 2.8' (2:1 normalized contrast).
10. Smear Versus Scan Angle	Assess smear as a function of scan angle location.	Accomplished mission goal.
11. Dense Culture Acquisition (1414)	Photo/EM correlation.	Accomplished; system performance verified.

4.1.9 Processing and Reproduction

Defilming of all RVs was accomplished without any major difficulty. Both TU core locking pins were sheared with the exception of RV-1. This resulted in approximately 100' of film being spilled in each RV during aerial recovery. Processing and reproduction of the 1414 and SO-255 Films was accomplished without incident. A minor delay in processing the FE-3916 was caused by film creases in a non-imagery area necessitating a machine cut in Op 694. SO-287, a new color duping film requiring a special reversal process, was used to generate all color duplicates. Magenta dye layer black and white duplicates were made of both type color records on SO-192 Film. Experimentally modified Redondo Printers were used to print the RV-4 second generation positives with modified chemistry. High contrast duplication was provided for specially designated targets and areas.

NPIC analyses have shown that the black and white duplicates from the original negative are similar in resolution transfer to previous 1200 series missions. The experimental second generation duplicate positive system is a good replacement for that previously used as it provides some improvement in highlight rendition. The black and white duplicates made from the color original positives (SO-255 on 1207-1 and FE-3916 on 1207-4) were similar to past 1200 series missions. The second generation color duplicate positives made on Aerial Color Print Film SO-287 provided a substantial improvement in resolution over that of SO-356 used on previous missions. However, the tone reproduction of SO-287 is poorer than both the color original positive and comparable copies made on SO-356 Film. The color duplicates made from the color IR original positive were judged good to excellent for color balance, but possessed poor resolution as a result of the low resolution capability of FE-3916.

4.1.10 Exploitation Suitability

The overall interpretation suitability on Mission 1207 was average, with the majority of the targets read out by NPIC rated a 4 on the National Imagery Interpretation Rating Scale (NIIRS). The introduction of NIIRS ratings in Mission 1207 has confirmed the relationship of the interpretability of a photograph to the basic acquisition conditions of weather, photo scale, obliquity, and solar elevation.

The new SO-287 Color Duplicate Positive Film resulted in an improvement in the exploitation capability of the color photography due to a higher resolution level than SO-356. The image quality of the color duplicate positive is still lower than the black and white duplicate positive, but many photointerpreters said that occasional color coverage of their targets was beneficial. Tone reproduction and color fidelity problems were noted in the color duplicate positive made from SO-255. An SO-356 color duplicate positive had to be substituted for the SO-287 duplicate positive for the wheat yield study.

The FE-3916 IR Color Original Positive Film, while of low resolution, resulted in good to excellent interpretation comments from the photointerpreters engaged in the wheat yield study.

4.2 MAPPING CAMERA SUBSYSTEM

4.2.1 Mapping Camera Operations and Performance

The Mission 1207 Mapping Camera Subsystem (RV-5) operated on 134 revolutions between Rev 6 and Rev 937. Recovery was affected on Rev 942. A total of 2,106 frames were exposed in the Terrain Camera and a corresponding number of frame pairs were exposed in the Stellar Camera. These exposures included 18 frames of 3414 Film exposed on the Terrain Camera for engineering evaluation, and 19 frames exposed for in-flight calibration.

Post flight analyses conducted at the processing site, the Mapping Camera Contractor's facility, and DMATC have shown that mission objectives were met with a high level of success.

The imagery acquired from both cameras was comparable to past missions. The Terrain Camera performed at expected levels based on acceptance test results, and the Stellar Cameras recorded an adequate distribution of sixth magnitude stars.

Except for the Stellar process marks, the ancillary data generated by both units was acceptable.

Weather conditions for the majority of the photography were fair to good with approximately 71% of the photography being 90% cloud free. Compared to previous missions, 1207 had the highest percentage (90%) of cloud free photography.

Table 4-6 summarizes the significant Mapping Camera Subsystem activities.

TABLE 4-6

SUMMARY OF SIGNIFICANT MAPPING CAMERA SUBSYSTEM ACTIVITIES

Rev	Activity	Event
-	Ascent	No anomalies.
7	Photography	Health check with programmed photography.
24	Photography	First indication of D platen press TM anomaly.
88	Photography	+Y shutter TM (S212) indicated shutter "not closed".
113	Photography	Bar XC acquisition.
405	Photography	Bar XC acquisition.
427	Photography	First indication of "D" capping shutter TM (S204) anomaly.
632	Photography	Bar XC acquisition.
932	Photography	3414 engineering.
933	Photography	3414 engineering.
934	Photography	3414 engineering.
936	Photography	ST in-flight calibration.
938	Photography	Attempt to photograph Comet Kohoutek.
939	Film runout	Unsuccessful film runout event due to stalled Terrain system.
942	RV-5 recovery	Successful air recovery of RV-5.

4.2.2 Mapping Camera Subsystem Data

The Mapping Camera Subsystem data for Mission 1207 is presented in Table 4-7.

TABLE 4-7

MAPPING CAMERA SUBSYSTEM STATISTICS

Camera Designations	Terrain	Stellar +Y	Stellar -Y
Focal Length (inches)	12.0156	9.9800	9.9686
Filter Type	WR-21	None	None
Reseau S/N	015	025	022
Lens S/N	004	008	010
Supply Spool S/N	050	104	
Supply Film Weight (lbs)	58.9	10.99	

— Film Data —

Terrain						
Type	3400	MCD	3414	MCD	3401	2403
Length (feet)	3,355	2.0	30	2.0	20	10
Stellar						
Type	3401		3400			
Length (feet)	2,000		100			

4.2.3 Image Quality

The majority of the Terrain Camera imagery was good and appeared consistent throughout the flight. The best imagery acquired was equal to the best of prior missions; however, there was less photography of cultured areas for comparison.

This was the first Mapping Camera Subsystem to use 3414 Film in the Terrain Camera. Thirty feet of this film was "tagged on" for special engineering tests. Test objectives were accomplished and the results support the plan to use this film as the primary load for the Terrain Camera effective with Mission 1209.

Stellar Camera imagery was good for both Plus and Minus Y, each camera recording between 50 and 100 images on evaluated frames.

Data derived from VEM analysis will not be included in this report. The duplicating film was changed from SO-467 to SO-284, and a matrix was not available to evaluate imagery on this film.

4.2.4 Exposure

Density measurements made at the processing facility indicated exposure levels for 1207 were correct and essentially the same as for Mission 1206.

4.2.5 Thermal Profile

There were no thermal control problems on this flight. Paint patterns, the same as those on 1206, provided excellent thermal distribution on the MISEA and EDAP Assemblies.

4.2.6 Pressure Profile

Average chute pressure stabilized at 45 micrometers. This was an increase of approximately 15 micrometers from the average level of Mission 1206. The increase was planned to supply pressure levels comparable to the corona free pressures experienced during ground testing. A maximum of 55 and a minimum of 29 micrometers were recorded during the flight.

4.2.7 In-Flight Calibration

In addition to the preflight calibration data, two additional calibration steps are conducted on-orbit. The two in-flight calibrations, range and stellar, are distinctly different operations.

Range calibration is conducted while operating the camera in the normal mode over a ground range containing accurately measured control points. A typical range is the Bar XC located in the Arizona/New Mexico area.

Stellar calibration was accomplished in two separate operations at the end of Mission 1207. This calibration required the vehicle to be positioned to an attitude that pointed all three camera lenses at the stars. The camera was then operated in the Calibrate Mode to record stellar imagery on the Terrain and Stellar formats simultaneously. Film Types 3401 and 2403 were used in the Terrain Cameras for this operation. Evaluation is currently in process to determine the calibration potential of the stellar imagery.

4.2.8 Summary of Anomalies

A. Telemetry Anomalies

(1) Anomaly - Terrain Platen Press (S-203)

Analysis

The first indication of the Press Telemetry anomaly occurred on Op 3, Rev 24. Nine frames were operated during this rev with telemetry switch S-203 indicating "No Press" on Frame 001, "Normal Press" with a TM spike at the end of Frame 002, and spikes at the beginning and end of a normal press on Frame 003. Anomaly characteristics at this time were similar to those experienced on 1206. Since flatness measurements and image evaluation conducted during post flight analysis of 1206 established that photography was not affected by this anomaly, normal programming was continued for 1207 operations. Correct T/M press indications were recorded until Op 55, Rev 265, when 3 frames of a 29 frame operation indicated a TM spike on the end of a normal press. On Ops 57 and 58, Rev 281, and continuing through Rev 479, S-203 indications were erratic.

There were no S-203 indications recorded from Revs 495 thru 720. On Revs 722 thru

736, there were eight S-203 indications during 55 frames before the telemetry again went inactive. On the last operation, there was one S-203 indication.

A number of frames were selected for flatness measurements at DMATC. The selection included samples of all the different press conditions, including normal operation, that were recorded during the mission. Reduction of the flatness measurements produced a standard deviation of less than 10 micrometers on all frames measured. Rejection criterion for these measurements at DMATC is 12.9 micrometers.

(2) Anomaly - Terrain Capping Shutter (S-204)

Analysis

On Op 78, Rev 427, the Terrain Capping Shutter Monitor (S-204) indicated "Closed" for one frame. Capping shutter occurrence (S-206) indicated normal operation for this frame. A tracking station problem was reported for this rev and the anomaly was attributed to loss of sync in the telemetry transmission. No action was taken and normal flight programming continued.

On the second operation of Rev 444, S-204 indicated the capping shutter remained "Closed" for 4 frames of a 21 frame operation. Since the telemetry data for this rev was processed through a different tracking station, a telemetry transmission problem was ruled out and an analysis of the problem from a camera standpoint was pursued.

S-204 is a microswitch TM monitor that indicates the capping shutter is starting to open. S-206, a rotary switch monitor, indicates capping shutter occurrence when the shutter approaches the full open position. For all "Closed" indications of S-204, S-206 reported normal operation. The problem was diagnosed as a telemetry microswitch malfunction and no further action was taken.

This anomaly occurred randomly throughout the remainder of the mission. In all cases, S-206 indicated normal operation of the capping shutter. A post flight evaluation of the photography substantiated the conclusion that this was a telemetry problem.

(3) Anomaly - Plus Y Shutter (S-212)

Analysis

On Rev 87 and continuing randomly to Rev 136, S-212 indicated that the Plus Y Shutter was not closing for every frame. Redundant monitor S-285 continued to indicate normal operation.

This problem occurred previously during integration testing in the B-mode and during Solo operations on 1206. All information indicated that this was a telemetry microswitch problem and normal operations were continued.

Evaluation of photography taken during this time did not indicate any shutter malfunction.

B. Terrain and Stellar Camera Systems Anomalies

(1) Anomaly - Terrain Transfer

At depletion of the Terrain film, the transport did not transfer all the film into the Take-up.

Analysis

The Terrain transport stalled on the fourth frame of Rev 938. The system subsequently operated normally, without take-up for two frames on Rev 989 and one frame on Rev 1054.

The Terrain Supply Torquer TM (S-101) showed a reduced level when the Terrain film supply was depleted. The data from the one frame on Rev 989 indicates the film was 6" to 9" from the Input Metering Roller when the system stalled.

The system was not designed to operate without Supply or Take-up tension. Possible damage and/or lockup of the starwheel mechanism is a high probability failure mode. Also, loose film in the transport could easily jam in several gear meshes or close Tolerance Roller configurations.

(2) Anomaly - Temperature Sensor (S-154)

Analysis

On Rev 719, Temperature Sensor S-154, located on the Plus Y side of the upper Terrain Shutter/Lens Assembly, indicated 81.5°F. Normal operating temperature for this sensor had been 73.4°F. Sensors 148, 152, and 154 are all associated with the heater for Thermal Zone 2; Sensors 148 and 152 continued to record normal operating temperatures and the problem was diagnosed as being sensor/circuit related.

(3) Anomaly - Hole in Aft Stellar Chute

A small light leak in the aft Stellar chute resulted in a superimposed image (pinhole camera effect) on the tenth frame toward the Take-up from the start of most operations. Pressure makeup equipment, located in the APSA, has been identified in the superimposed imagery.

Analysis

Illumination of the pressure makeup equipment was provided through the lightening holes located on the bottom aft face of the APSA and reflection off the silvered chute sections.

Extensive analysis, which included simulated photography and pinhole viewing, has located the position of the hole in the aft chute, approximately 6" forward of the rivets which attach the grounding strap bracket to the chute section.

Observations

The following observations have been derived from this analysis:

(a) There are no attachments or rivets located in this area of the chute that are potential apertures for light leaks.

(b) The position of the chute seam is limited by the length of the grounding strap to areas that are outside the view of the imagery acquired.

(c) A hole of approximately .070" was necessary to produce this imagery.

(d) Light leak tests conducted prior to flight did not indicate any signs of a hole.

(e) The chute sections and pressure makeup equipment are installed in the APSA prior to light leak tests and mating with the vehicle. Upon completion of the light leak tests, no further work in this area is required of the camera contractor.

Conclusions

The conclusions are:

(a) The location of the suspected hole is in a position that precludes the possibility that loose, broken, or improperly installed hardware caused the leak.

(b) The precise cause of the leak is unknown at this time.

(4) Anomaly - Stellar Process Marks

Analysis

Stellar process marks were noted throughout this mission but were not of sufficient density to activate the optical tilting device. This condition was a result of changing the Stellar Transport Assembly during integration testing. The replacement transport from SV-8 had been updated with improved process markers that require higher current levels for proper illumination. Common circuitry controls the density levels of both the Terrain and Stellar process marks making it difficult to optimize density levels for both cameras when unit designs are different.

4.2.9 Exploitation Suitability

The technical analysis of the Mission 1207 imagery by the DMA Post Flight Analysis Team included a comparison of the photography with the system specifications. As a result of the instrument measurements and various other metric evaluations, the system was determined to have provided all necessary data and to have satisfied all critical performance requirements.

4.2.10 Processing and Reproduction

The RV arrived at the processing site in good condition at 1500 hours GMT on 8 January 1974. The cut/seal mechanism was closed and the temperature tabs located on the lip of the RV were intact and appeared normal. The tag ends of film were free of the cutter assembly and clean serrated cuts on both the Stellar and Terrain records were noted.

Approximately 15' of the Terrain record was over the spool flange. The Anti-backup Solenoid was not operating on the Terrain Take-up.

The Stellar record was approximately 1/8" below the top of the spool flange. No static discharges were noted during the despooling operation.

All camera records were processed on 8 and 9 January 1974. The Stellar record could not be optically titled because the process marks could not be adequately detected at the infrared viewing station. The Terrain record was not optically titled due to a problem in the optical titling software. Therefore, both records were titled manually. Post-mission simulations have recreated the problem and the software is presently being modified.

All duplicate copies were printed on the Kingston Printer. Duplicate positives of the Terrain 3400 and 3401 Films were prepared using Aerial Duplicating Film (Estar base) SO-284 and those for the 3414 Film were prepared using High Resolution Aerial Duplicating Film (Estar base) SO-192. Duplicate positives of the Stellar record were prepared using Aerographic Duplicating Film (Estar base) 2420. All duplicate negatives were prepared using Direct Duplicating Aerial Film (Estar base) 2422. Viscous Dalton Processors were utilized for all duplicate processing.

[redacted]

4.4 SUBSATELLITES

Two subsatellites were carried into orbit on SV-7. A 450 pound Subsatellite Unit (SSU) was carried on the Minus Y side of the Forward-section. Separation of this subsatellite occurred on Rev 13.5 following an SV yaw maneuver of -23.5 degrees. Separation occurred at -11.8° latitude on the descending node. All subsatellite separation sequence events were within specified limits and the subsatellite went on to achieve its desired orbit.

[redacted] Subsatellite was carried on the Plus Y side of the Forward-section. Separation of this subsatellite occurred on Rev 2.9 which coincides with 22.1° South latitude on an ascending node. The subsatellite separation sequence was within desired tolerances and the subsatellite achieved its intended orbit.

PERFORMANCE EVALUATION TEAM
REPORT NO. 1207/74

SECTION V

RE-ENTRY VEHICLE SUMMARY

5.1 SUMMARY

The recovery statistics are shown in Table 5-1. All RV events (on-orbit, re-entry, and recovery) occurred as planned and the RV flights followed the predicted trajectories.

The outer wraps of film on RV-2, RV-3, and RV-4 were loose due to relative motion between the film stacks and the RV after aerial retrieval induced shearing of the core pins. Aerial retrieval loads exceeding the core pin strength are expected. The payload on RV-1 was recovered without loose wrapping.

All subsystems performed satisfactorily and met all mission requirements.

5.2 RE-ENTRY VEHICLE PERFORMANCE

All RV on-orbit functions were normal and occurred on time. The SV provided a satisfactory pitch angle for each separation. All other SV/RV interface functions were nominal. The RVs were adequately spin stabilized during the vacuum coast phase and aerodynamically stable during the atmospheric phase of the re-entry trajectory.

5.3 RE-ENTRY VEHICLE SUBSYSTEM PERFORMANCE

Two discrepancies were observed during the post flight examination of the recovered vehicles.

A. Batteries

On RV-4, the Main Battery vented a small quantity of electrolyte through the overboard vent during post retrieval shipment. Corrective action consisting of a battery case leak test has been incorporated effective with SV-10. Retrofitting was not deemed necessary.

B. VHF Antenna

One antenna was missing at the time of boarding RV-4 on the recovery aircraft. Signal strength recordings indicate that the strength levels and patterns appear normal by comparison with previous flights. No data indicates the antenna was missing prior to aerial recovery.

5.4 STELLAR TERRAIN RECOVERY (RV-5)

RV-5 was successfully recovered on Rev 942. Recovery statistics are shown in Table 5-2. All RV subsystems performed normally. The SV provided a satisfactory pitch angle after a yaw reverse. All other RV/SV interface functions were nominal.

The miss distance between the predicted impact point (PIP) and the estimated point of parachute deployment (EPPD) was calculated to be 33.46 NM short and 1.94 NM east of the ground track. The capsule was recovered at 12,000' on the first pass.

TOP SECRET-HEXAGON

TABLE 5-1

RECOVERY VEHICLE RECOVERY SUMMARY

	RV-1	RV-2	RV-3	RV-4
RV Serial No.	32	31	30	29
Recovery Rev No.	229	602	1039	1656
Recovery Date	24 Nov 1973	17 Dec 1973	13 Jan 1974	20 Feb 1974
Payload Weight (lbs) (Measured weight from recovered RV)				
Forward	227.7	203.0	228.3	184.6
Aft	230.3	204.0	228.7	185.4
Unbalance Percent	1.0	0.4	0.2	0.3
SV Orbit (hp x ha/ωp)	88.29 x 153.76/122.92	90.31 x 147.76/145.42	90.57 x 166.17/147.73	90.22 x 153.66/130.21
SV Pitch Angle (degrees)	-33.8	-37.5	-40.6	-37.4
Nominal PIP Latitude	31.00	26.00	17.00	25.50
Impact Location Error (EPPD versus Teapot Eval)				
Overshoot (NM)	18.5	2.1	10.9	
Undershoot (NM)				3.4
Cross-Track (NM)	2.5E	1.0E	4.2E	4.3E
Recovery (Aerial)				
Altitude (feet)	14,000	12,300	10,800	10,300
Parachute Condition	Normal	Normal	Normal	Minor cone damage. One suspension line broken.
Retrieval Pass	1	1	1	2
Recovery Capsule Payload Condition	Good	Good	Good	Good

NOTES: 1. hp = Altitude of Perigee (NM)
2. ha = Altitude of Apogee (NM)
3. ωp = Argument of Perigee (degrees)

TOP SECRET-HEXAGON

BYE 15319-74
Handle via Byeman
Controls Only

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TABLE 5-2

RV-5 RECOVERY SUMMARY

Recovery Rev	942
Date	7 January 1974
Payload Weight (lbs)	68.78
SV Recovery Orbit	
Perigee (NM)	90.24
Apogee (NM)	154.4
Argument of Perigee (degrees)	124.9
SV Pitch Angle after yaw around (degrees)	-63.3

	PIP	EPPD	Air Recovery
Latitude	16° 0.4'	16° 33'	16° 20'
Longitude	154° 1.2'	153° 53'	153° 45'
Altitude	-	-	12,000'

SECTION VI

OPERATIONAL SUPPORT

6.1 SOFTWARE

The software configuration used to support Mission 1207 was 'TUNITY MOD 2, with no significant changes from the previous mission. AOES/System II configuration was 13.1FS, Corrector Tape CT 13.1F 7B. A nominal one rev load cycle for the payload revs was used during the mission phase. A total of 1,087 command messages were generated, of which 924 were loaded into the vehicle. Ten software problems (SPRs) were encountered during the mission phase and considered flight critical. These SPRs are discussed below:

6.1.1 SPR MD2-6316 ('TOREP)

The MPR users determined that 'CFB need 11 place accuracy rather than 9. This accuracy was provided.

6.1.2 SPR MD2-6318 ('TMOUND)

For camera operation on Rev 91, the SLW bias was incorrectly applied. An ideal SLW is calculated which limits at maximum value (.910), then looks for a bias. The ideal value can be well over .910 at low sun angles hence causing underexposure. The modification to 'TMOUND corrected the procedure.

6.1.3 SPR MD2-6323 ('TSTAGEN)

The SP generator would not accept separate STA cards for both a mode change and SGLS change. This occurrence was too frequent and inconvenient to message generation to warrant only a work-around.

6.1.4 SPR MD2-6324 ('TBALL)

A camera operation on Rev 135 contained two automatics and a MOP. The op score was improperly handled on the first automatic. The user was correctly informed and the modification to 'TBALL made.

6.1.5 SPR MD2-6325 ('TSTAGEN)

'TUNITY improperly handled an ACES broken pass (two segments) by misplacing a Format D Select command. Regeneration of the message was required and modification of 'TSTAGEN solved the problem.

6.1.6 SPR MD2-6348 ('TOREP)

'TOREP provided the wrong clock coefficients because it did not observe the UTC discontinuities as required at year end. This resulted in a one second error. The modification provided the same modeling as that in the AOES SCLOCK routine.

6.1.7 SPR MD2-6351 ('TFUNCHK)

A MOP on Rev 1222 had 4 frames on the Forward and 1 on the Aft due to a misplacement of the

FT- command. The work-around was assuring a minimum of 5 frames for a MOP. The modification to 'TFUNCHK was the incorporation of calculating and checking the number of frames required.

6.1.8 SPR MD2-6352 ('THISUM)

The CHG run was aborting when attempting to read a non-existent record zero. The modification provided a response to this situation.

6.1.9 SPR MD2-6356 ('TAPOUT)

A bounds violation occurred during tape recorder log for Message 730 and communications and messages could not be updated until the software was corrected.

6.1.10 SPR MD2-6357 ('TAPOUT)

The 'TAPOUT summary listing for Message 120 update contained erroneous output and could not be used until 'TAPOUT was modified.

6.2 SATELLITE CONTROL FACILITY (SCF)

The performance of the SCF in support of 1207 was commendable. However, some equipment and operational problems were encountered which caused minimal impact on the mission. Command message generation and transmission, and downlink TM reception and processing were satisfactory to support the operation.

6.2.1 Readiness

A 34 rev Dress Rehearsal using 'TUNITY MOD 2 and MODEL 13.1F was begun on 30 October 1973 and successfully concluded on 1 November 1973.

6.2.2 Orbit Operation

One dedicated CDC 3800 Computer was used throughout the operation; a second computer was used for 722 hours of operation. The computer usage rate was 1.38 computers per day. In general, some poor tape recorder data caused a delay in MPR generation and a number of additional command messages were required to bring up alternate remote tracking station (RTS) support. The more significant RTS problems are as follows:

A. HULA Rev 269

Tape recorder data lost due to personnel error.

B. POGO Revs 308, 311, and 329

Loss of the SGLS transmitter caused some loss of tape recorder data and required bringing up additional RTS for mission support.

C. POGO Rev 372

A time critical tape recorder command was missed due to personnel error causing loss of some data.

D. KODI Rev 625 and 966

RTS computer down requiring reprofiling of load station.

E. POGO Rev 981 thru 983

No command capability and a message not loaded. To provide protection against further long term outage, BOSS Subcycle 6 or 7 was routinely scheduled as an alternate load station for the remainder of the mission.

F. KODI Rev 1436

SGLS transmitter failure prevented loading of a payload message.

A substantial effort on the part of the Field Test Force, primarily the CG and the TA Staff was expended in support of SV-8 development and readiness in parallel with mission support. These activities included:

A. SV-8 Development Exercise (11 to 16 February 1974).

B. SV-8 Mode development.

C. SV-8 Orbit case study and evaluation.

6.2.3 Recovery Operations

A. Recovery 1207-1

Preparation, deorbit and entry events, and drogue and main parachute deployment conditions were normal and executed as planned. Aerial recovery was accomplished on the first pass at 14,000' altitude, 20.7 NM from the predicted impact point.

B. Recovery 1207-2

Aerial recovery was accomplished on the first pass at 12,300' altitude, 20 NM from the predicted impact point. The recovery forces reported the parachute cone looked soft and fell several times at an altitude of 16,000', but that it was erect and stable prior to recovery. The RV and chute were reported in normal condition.

C. Recovery 1207-3

Aerial recovery was accomplished on the first pass at 10,800' altitude, 6.5 NM from the predicted impact point. At the time of recovery, the recovery aircraft's LORAN and Doppler Computer were malfunctioning and they were using the SRU TACAN for positioning. The aerial recovery location was later derived from this information in the navigator's log. The heat shield was also recovered.

The recovering aircraft reported the Delta 3 (water recovery) Beacon was received immediately after recovery contact. This later proved to be caused by a malfunctioned switch on the recovery aircraft, which when turned to the Delta 3 frequency remained at the Delta 2 frequency.

D. Recovery 1207-4

Aerial recovery was accomplished on the second pass at 10,300' altitude, 20.5 NM from the predicted impact point. The recovery forces reported that the VHF antenna on the drogue mortar hole side of the RV was missing. One heavy suspension line was broken and a possible tear in the upper part of the main canopy was also noted.

E. Recovery 1207-5

Aerial recovery was accomplished on the first pass at 12,000' altitude, 33.5 NM from the predicted impact point.

6.2.4 Command Message Generation

APPENDIX A

GLOSSARY OF TERMS

ACS	Attitude Control System.
ATC	Active Thermal Control.
BV	Booster Vehicle.
BV/SV	Booster Vehicle/Satellite Vehicle.
DBS	Doppler Beacon System.
ECS	Extended Command System.
EDAP	Electrical Distribution and Power.
EPPD	Estimated Point of Parachute Deployment.
GFE	Government Furnished Equipment.
H/S	Horizon Sensor.
ips	inch(es) per second.
MCM	Mapping Camera Module.
MCS	Minimal Command System.
MMC	Martin Marietta Corporation.
NM	nautical mile(s).
NVR	Non-volatile Residue.
OA	Orbit Adjust.
OAS	Orbit Adjust System.
OOAA	On-Orbit Adjust Assembly.
PACS	Primary Attitude Control System.
PCM	Pulse Code Modulator.
PDWN	Pitch-down.
PFA	Post Flight Analysis.
PGR	Pitch Gyro Rate.
PIP	Predicted Impact Point.
PMS	Pressure Makeup System.
PMU	Programmable Memory Unit.
PST	Pacific Standard Time.
PWM	Pulse Width Modulator.
RACS	Redundant Attitude Control System.
RCS	Reaction Control System.

APPENDIX A (CONT'D)

REA	Reaction Engine Assembly.
REM	Reaction Engine Module.
Rev	Revolution.
RTS	Remote Tracking Station.
RV	Re-entry Vehicle.
SBA	Satellite Basic Assembly.
SBAC	Satellite Basic Assembly Contractor.
SECO	Stage II Engine Cut-Off.
Sep	Separation.
SGLS	Space Ground Link System.
Solo	System Engineering Test after Fourth RV Separation.
SPC	Stored Program Command.
SRM	Solid Rocket Motor.
[redacted]	
SSU	Subsatellite Unit.
ST	Stellar Terrain.
ST/RV	Stellar Terrain/Re-entry Vehicle.
SU	Supply Unit.
SV	Satellite Vehicle.
TT & C	Telemetry, Tracking, and Command.
TVC	Thrust Vector Control.
VBE	Variable Block Erase.
Vx/h	Orbit Angular Rate, In-Track.